NDCEE

National Defense Center for Energy and Environment

Munitions Metals and Residue Treatment for Active Range Restoration

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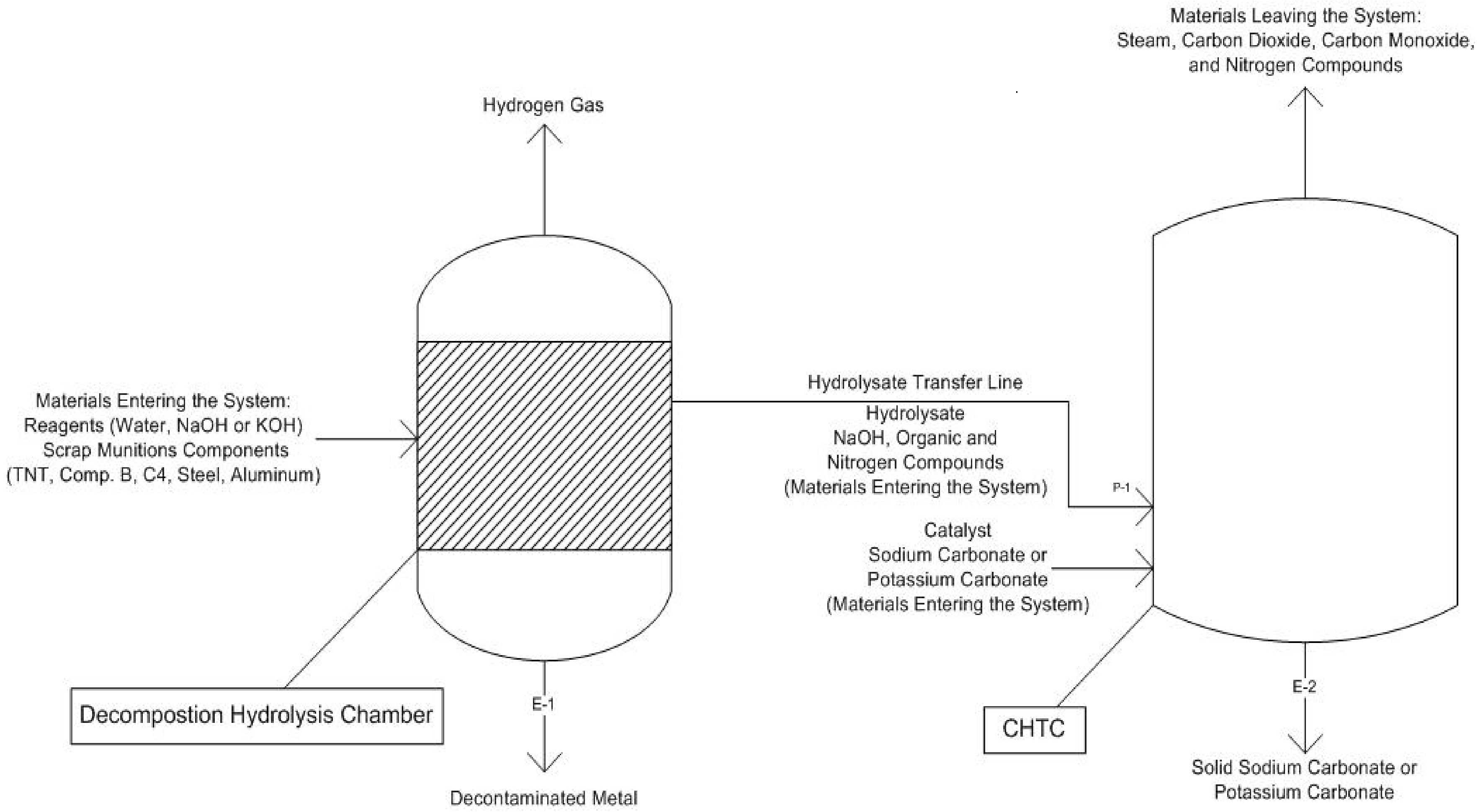
Background

- Energetic materials on ranges pose a potential for off-site transport.
  - Conventional methods such as open burning/open detonation have been found to distribute energetic materials on ranges.
  - Converting chunk material to non-hazardous products provides good land stewardship.
- The technology being developed and demonstrated will be capable of converting explosive residue to non-hazardous products through base hydrolysis and catalytic hydrothermal conversion (CHTC).

Open Burning/Open Detonation Site at Hawthorne Army Depot
(http://ndep.nv.gov/hwad/hwadg01c.htm)

Process Flow Diagram (PFD) of the Conceptual CHTC System



CHTC Dem/Val Approach

- Determine and implement process requirements that will prepare technology for full scale validation testing.

- Develop a test and safety plan that will safely and effectively test the technology's ability to convert explosive residues to water and non-hazardous gases.

- Demonstrate the technology in a way that will produce the data necessary to determine the effectiveness of the technology as well as its applicability at DoD installations.

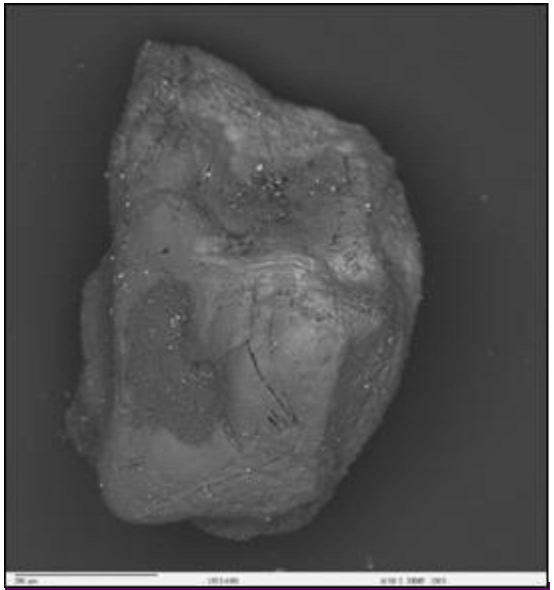


Photo of chunk energetic material (approximately 400μm across) provided by USAEC

Accomplishments and Results

- Designed and modified concept components of the system to increase efficiency and meet reliability, ruggedness, and throughput requirements.
- Compiled system requirements and design questions for the overall CHTC system. Specific areas for which requirements were developed include:
  - CHTC Sub-System Upgrades
  - Decomposition/Hydrolysis System Requirements
  - Operational Concept
  - Improvements from the SERDP Project.
- Reviewed and prepared a summary of the "Base Hydrolysis Process for the Destruction of Energetic Materials" (2001) Final Report prepared for Assembled Chemical Weapons Assessment by the US Army Tank-Automotive Armament Command-Armament Research, Development, and Engineering Center (TACOM-ARDEC) for background information on the hydrolysis reaction of energetic materials with sodium hydroxide.
  - Concluded that base hydrolysis with sodium hydroxide (NaOH) is a proven process for the effective destruction of energetics recovered from the demilitarization of chemical weapons.

Accomplishments and Results (cont.)

- Modeled the kinetics and thermodynamics of the hydrolysis and polymerization reaction.
- Conducted bench-scale evaluation of energetic neutralization via caustic hydrolysis.
  - Reaction calorimeter (Mettler RC1 reactor)
  - Test parameters:
    - Selected NaOH and potassium hydroxide (KOH) as the caustic solutions for base hydrolysis reactions
    - Tested Trinitrotoluene (TNT), Composition B Explosive (Comp B), and C4
    - Added aluminum to determine the impact of hydrogen gas generation

Mettler RC1 reactor used for bench-scale evaluations

Accomplishments and Results (cont.)

- Results of bench-scale evaluation:
  - TNT and Comp B were readily consumed in the base hydrolysis reaction
  - C4 was not solubilized in the reaction
    - Due to its composition of 10% polyisobutylene
  - Hydrolysate residue from two test runs (TNT and KOH and Comp B and KOH) were subjected to drop weight tests (ASTM E680)
    - Verified that the hydrolysate was safe and no longer displayed explosive characteristics
    - Quantified drop weight test results of Comp B and NaOH and TNT and NaOH by analogy from previous work

Energetic	Chemical Composition
TNT	2,4,6-trinitrotoluene
Composition B Explosive (Comp B)	60% RDX, 39% TNT, 1% poly-isobutylene
C4	90% RDX, 10% polyisobutylene

Path Forward

- Build the CHTC subsystem;
- Design and build the decomposition/hydrolysis subsystem;
- Bench-scale test the decomposition/hydrolysis and CHTC subsystems with TNT, Composition B, and C4;
- Incorporate any improvements from the bench-scale testing into the final CHTC system design;
- Develop operation and safety manual;
- Develop demonstration plans; and,
- Perform the demonstration on an active range using energetic materials found on the range.

Project Stakeholders

- U.S. Army Training Support Center (ATSC)
- U.S. Army Cold Regions Research and Engineering Laboratory (CRREL)
- Department of Defense Explosives Safety Board (DDESB)
- Deputy Chief of Staff for Operations, G3
- Office of the Deputy Assistant Secretary of the Army (Environment Safety and Occupational Health) (ODASA (ESOH))
- URS Corporation
- U.S. Army Corps of Engineers (USACE)
- U.S. Army Environmental Command (USAEC)
- U.S. Army Technical Center For Explosive Safety (USATCES)
- U.S. Navy

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